

**REMARKS**

**Summary of the Office Action**

Claims 1, 9, and 14-17 stand rejected under 35 U.S.C. § 102(b) as being anticipated by *Zhang et al.* (US 6,441,417 B1).

Claims 2-8, 10-13, and 18-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Zhang et al.* in view of *Selbrede et al.* (US 2004/0025787 A1).

**Summary of the Response to the Office Action**

Applicant has amended claims 1, 6, 9, and 19 to further define the invention. Applicant has canceled claim 2. Accordingly, claims 1 and 3-23 are pending for consideration.

**Withdrawal of Rejection Under 35 U.S.C. § 102(b)**

Claims 1, 9, and 14-17 stand rejected under 35 U.S.C. § 102(b) as being anticipated by *Zhang et al.* (US 6,441,417 B1). Applicant respectfully traverses these rejections for at least the following reasons.

Applicant respectfully asserts that the application date of PCT/JP03/10456 is August 19, 2003. Accordingly, the application date of the present application is August 19, 2003. Applicant respectfully asserts that the publication date of *Zhang et al.* (US 6,441,417 B1) is August 27, 2002. Accordingly, Applicant respectfully asserts that the rejection under 35 U.S.C. § 102(b) as being anticipated by *Zhang et al.* (US 6,441,417 B1) is incorrect and therefore should be withdrawn.

In addition, Applicant respectfully asserts that independent claims 1 and 9, as amended, and dependent claims 14-17 are allowable over *Zhang et al.* at least because of the features recited therein.

**Rejection Under 35 U.S.C. § 103(a)**

Claims 2-8, 10-13, and 18-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Zhang et al.* (US 6,441,417 B1) in view of *Selbrede et al.* (US 2004/0025787 A1). Applicant respectfully traverses these rejections for at least the following reasons.

Independent claims 1 and 9, as amended, incorporate the features of original claim 2 and recite, in part, "a metal-ferroelectric-insulator-semiconductor (MFIS) transistor comprising an insulating buffer, wherein a ratio among said hafnium element and said aluminum element in the insulator buffer layer being  $\text{Hf}_{1-x}\text{Al}_{2x}$ , wherein constitution ratio  $x$  is within  $0 < x < 0.7$ ."

Independent claims 6 and 19, as amended, recite "a metal-ferroelectric-insulator-semiconductor (MFIS) transistor comprising an insulating buffer having a hafnium oxide or a hafnium-aluminum oxide as a main component and contains a nitrogen element as an additive," (emphasis added).

Applicant respectfully asserts that the Office Action has pieced together *Zhang et al.* and *Selbrede et al.* to teach the claimed features. However, MPEP § 2143.01 instructs that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680, 16 USPQ 2d 1430 (Fed. Cir. 1990)." MPEP § 2143.01 further instructs that "[a]lthough a prior art device 'may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so.'" Applicant respectfully asserts that the references do not provide such a suggestion or motivation.

In particular, Applicant respectfully asserts that, as a result of repeated trial-and-errors,  $\text{Hf}_{1-x}\text{Al}_x\text{O}_{2+x+y}$  ( $0 < x < 0.7$ ), as recited in claims 1 and 9, and nitrogen-doped  $\text{HfO}_{2+u}$  or nitrogen-doped  $\text{Hf}_{1-x}\text{Al}_x\text{O}_{2+x+y}$  (without any restriction in the range of  $x$  and  $y$ ), as recited in claims 6 and 19, were found to have very small leakage current due to its amorphous state when it is used as an insulating buffer layer of MFIS structure and was also found to have long retention time. Although Hf-Al-O or Hf-O may have been known to one of ordinary skill in the art as an insulator, Applicant respectfully asserts that the specific composition of  $\text{Hf}_{1-x}\text{Al}_x\text{O}_{2+x+y}$  ( $0 < x < 0.7$ ) or nitrogen-doped  $\text{HfO}_{2+u}$  or nitrogen-doped  $\text{Hf}_{1-x}\text{Al}_x\text{O}_{2+x+y}$ , when used in ferroelectric memory with MFIS structures, is not known to one of ordinary skill in the art to significantly reduce the leakage current and to elongate the retention time.

In addition, Applicant respectfully asserts that the leakage current in *Zhang et al.* is in the order of  $10^{-6}$  A/cm<sup>2</sup>, as set forth in column 3, lines 31 to 32. In contrast, in the present application, the leakage current is  $3 \times 10^{-10}$  A/cm<sup>2</sup>, as shown in Fig. 8, and is  $2 \times 10^{-9}$  A/cm<sup>2</sup>, as shown in Fig. 10. Accordingly, in comparison with the value of  $1 \times 10^{-6}$  A/cm<sup>2</sup> in *Zhang et al.*, the leakage current is reduced roughly by the order of three. Therefore, Applicant respectfully asserts that there is no suggestion or motivation to combine the features in *Zhang et al.* with that of *Selbrede et al.*

Furthermore, the Office Action alleges that *Selbrede et al.* discloses a film formation process for  $\text{HfO}_2$ ,  $\text{HfAlO}_4$ , and nitrogen-containing compounds thereof. Applicant respectfully asserts that *Selbrede et al.* fails to disclose any description or suggestion on the use of the insulating layer fabricated by the disclosed process as the insulating buffer layer for an MFIS structure transistor, as claimed in independent claims 1, 6, 9, and 19. Thus, Applicant

respectfully asserts that the Office Action has not established a *prima facie* case of obviousness and that the rejections under 35 U.S.C. § 103(a) should be withdrawn.

For at least the above reasons, Applicant respectfully asserts that independent claims 1, 6, 9, and 19 are neither taught nor suggested by the applied prior art references, whether taken alone or in combination. As pointed out in MPEP § 2143.03 instructs that "[t]o establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. Thus, Applicant respectfully asserts that the rejection under 35 U.S.C. § 103(a) should be withdrawn because neither *Zhang et al.* nor *Selbrede et al.* teach or suggest each feature of independent claims 1, 6, 9, and 19, and hence dependent claims 3-5, 7, 8-18, and 20-23 are allowable.

### **Conclusion**

In view of the foregoing, Applicant respectfully requests reconsideration and the timely allowance of all pending claims. Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicant's undersigned representative to expedite prosecution.

If there are any other fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-0310. If a fee is required for an extension of time under 37 C.F.R. § 1.136 not accounted for above, such an extension is requested and the fee should also be charged to our Deposit Account.

Respectfully submitted,

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